इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 6567 (1972): Radiation protection for an X-ray tube in a protective tube-housing,operating between 10kV and 400 kV [LITD 4: Electron Tubes and Display Devices]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

Indian Standard
RADIATION PROTECTION FOR AN X-RAY TUBE IN A PROTECTIVE TUBE HOUSING, OPERATING BETWEEN 10 kV AND 400 kV

UDC 621·386·2 : 614 876

© *Copyright* 1972

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 1

Price Rs 5 *August* 1972

AMENDMENT NO. 1 SEPTEMBER 1974
TO
IS : 6567-1972 RADIATION PROTECTION FOR AN X-RAY TUBE IN A PROTECTIVE TUBE HOUSING, OPERATING BETWEEN 10 kV AND 400 kV

Corrigendum

(*Page* 5, *Table* 1, *col* 3, *last line*) — Substitute '100 mR' *for* '10 mR'

(ETDC : 39)

Printed at New India Printing Press, Khurja, India

Indian Standard

RADIATION PROTECTION FOR AN X-RAY TUBE IN A PROTECTIVE TUBE HOUSING, OPERATING BETWEEN 10 kV AND 400 kV

Electron Tubes Sectional Committee, ETDC 39

Chairman

PROF S. SAMPATH

Indian Institute of Technology, Madras

Members	*Representing*
DR S. S. S. AGARWALA	Central Electronics Engineering Research Institute (CSIR), Pilani
SHRI H. K. L. ARORA	All India Radio and Electronics Association, Bombay
SHRI R. C. KESWANI (*Alternate*) (Bombay)	
SHRI ARUP CHAUDHURI (*Alternate*) (Calcutta)	
SHRI S. NATARAJAN (*Alternate*) (Madras)	
SHRI BALRAJ BHANOT	Directorate General of Technical Development
DIRECTOR, ELECTRICAL ENGINEERING	Naval Headquarters (Ministry of Defence)
DIRECTOR, ELECTRONICS & RADAR DEVELOPMENT ESTABLISHMENT	Directorate General of Research & Development (DGRD) (Ministry of Defence)
SHRI B. P. GHOSH	National Test House, Calcutta
SHRI R. K. JAIN	Radio Electronic & Television Manufacturers' Association (RETMA), Calcutta
SHRI S. B. PAI (*Alternate*)	
SHRI S. C. MAJUMDAR	Directorate General of Civil Aviation (Ministry of Tourism & Civil Aviation)
SHRI A. V. RAJU	Directorate of Technical Development & Production (Air) (Ministry of Defence)
SHRI P. M. SHANKAR RAO (*Alternate*)	
SHRI P. K. RAO	Directorate General of Inspection (Ministry of Defence)
KUMARI V. SURYAKANTHI (*Alternate*)	
SHRI S. N. SEN	All India Radio, New Delhi
SHRI G. H. VAZE	Bhabha Atomic Research Centre, Bombay
DR R. P. WADHWA	Bharat Electronics Ltd, Bangalore
SHRI Y. S. VENKATESWARAN, Director (Elec tech)	Director General, ISI (*Ex-officio Member*)

Secretary

SHRI N. SRINIVASAN

Deputy Director (Elec tech), ISI

(*Continued on page* 2)

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 1

(*Continued from page* 1)

Panel for X-Ray Tubes, ETDC 39 : P 3

Convener	*Representing*
SHRI A. V. RAMACHANDRA RAO	Bharat Electronics Ltd, Bangalore
Members	
DR SWAMINATHAN JAYARAMAN	Directorate of Radiation Protection (Bhabha Atomic Research Centre), Bombay
SHRI V. KRISHNAMOORTHY	Directorate General of Technical Development
SHRI V. S. RAO	Directorate General of Inspection (Ministry of Defence)
SHRI A. S. KRISHNAMURTHY (*Alternate*)	

Indian Standard

RADIATION PROTECTION FOR AN X-RAY TUBE IN A PROTECTIVE TUBE HOUSING, OPERATING BETWEEN 10 kV AND 400 kV

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 7 May 1972, after the draft finalized by the Electron Tubes Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The manufacture of medical X-ray equipment has been taken up in India on a substantial scale and X-ray tubes for the same are being manufactured within the country. An Indian Standard specification for diagnostic type of X-ray tube has already been brought out (*see* IS : 3154-1965*).

0.3 According to International Commission on Radiological Protection regulations and also according to the regulations laid down by the Department of Atomic Energy, Government of India regarding the radiation protection of X-ray tubes fitted in a protective tube housing and filled with appropriate insulating oil, the level of leakage radiation should not exceed certain specified limits for different types of X-ray tubes. This standard lays down such limits and the corresponding methods of measurement.

0.4 Although the protective measures are to be provided as an integral part of the X-ray equipment and if properly used will provide protection to the patient, they will not always by themselves be sufficient for protection of the radiological staff and the occupants of the surrounding areas. Additional protection measures such as structural shielding and the wearing of protective clothing may, therefore, be required. These additional requirements are usually unique to each installation since they are affected by work load, occupancy factor, etc, and thus only measurements or estimates of patient exposure and personnel exposure will give information about any necessary additional protection. This standard is expected to be of use in evaluating these levels also.

0.5 It is the duty of both the manufacturer and the user to ensure that the radiation protection measures in respect of all equipment are in conformity with the standard (and particularly with the regulations laid down by the Department of Atomic Energy, Government of India). In the case of very intensive or unusual application of the equipment, it is the duty of the user to provide additional protective measures or procedures, if necessary.

---

*Specification for X-ray tubes, diagnostic type.

0.6 This standard is one of a series of Indian Standards on electron tubes. A list of standards so far prepared on this series is given on page 8.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down the limits of leakage radiation from X-ray tube in a protective tube housing, operating between 10 kV and 400 kV and the corresponding method of measuring the same.

2. TERMINOLOGY

2.1 For the purpose of this standard, the terms and definitions given in IS : 1885 (Part IV/ Sec 2)-1965† shall apply.

3. PROTECTION AGAINST LEAKAGE RADIATION FROM X-RAY TUBE HOUSING

3.1 The leakage radiation from protective tube housings shall not exceed the values given in Table 1 when measured in accordance with the procedures laid down in this standard.

3.2 Limiting Device for X-Ray Beam — The protective tube housing provided for each X-ray tube shall have an aperture or a window of such a size as to allow not more than the largest necessary useful beam to emerge. In situations where only a beam size smaller than the maximum possible is required, an additional fixed size diaphragm or other suitable device shall be provided which will limit the beam size to that required. The transmitted intensity through the beam limiting device should not exceed 5 percent of the useful beam in the case of therapy tubes. For diagnostic types, the beam limiting device should offer the same degree of attenuation as that of the tube housing.

4. RADIATION MEASURING DEVICE

4.1 Survey Meter — A survey meter is an exposure rate meter which is intended to be the principal measuring instrument for probing or rapid

---

*Rules for rounding off numerical values (*revised*).

†Electrotechnical vocabulary: Part IV Electron tubes and valves, Section 2 X-ray tubes.

TABLE 1 MAXIMUM PERMISSIBLE EXPOSURE RATE OF LEAKAGE RADIATION

(*Clause* 3.1)

SL No.	TYPE OF TUBE ASSEMBLY	MAXIMUM PERMISSIBLE EXPOSURE RATE OF LEAKAGE RADIATION
(1)	(2)	(3)
i)	Diagnostic type protective tube housing	The protective tube housing shall be so constructed that at every specified rating of the x-ray tube, the leakage radiation at a focal distance of 1 m does not exceed 100 mR per hour
ii)	Therapeutic-type protective tube housing:	
	a) Operating above 50 kV	The protective tube housing shall be so constructed that at every specified rating of the x-ray tube, the leakage radiation at a focal distance of 1 m does not exceed 1 Roentgen per hour; or 30 Roentgens per hour at any point accessible to the patient at a distance of 5 cm from the surface of the housing or its accessory equipment.
	b) For therapeutic-type protective tube housing with operating potentials up to and including 50 kV which may be occasionally held in the hand during treatment	The protective tube housing shall be so constructed that at every specified rating of the x-ray tube, the leakage radiation at 5 cm from the surface of the tube housing shall not exceed 10 mR per hour

surveying of a radiation field. The time constant of such an instrument should preferably be less than one-third of the duration of the radiation or the response time (the time taken to reach the maximum reading) of the instrument should as far as possible be equal to or less than the duration of the radiation (that is, for example maximum possible exposure time of a diagnostic X-ray tube).

NOTE — Ionization chamber detectors having a flat response (energy independent response) in the energy region of interest are generally used. Other detectors such as Geiger-Muller counters, proportional counters, scintillation crystals or solid state detectors may also be used provided the detector is appropriately calibrated and corrected for energy dependence.

4.1.1 In order to average the exposure of small beams over the appropriate area, the detector to be used for measurements at one metre distance from the focal spot shall have an area of approximately 100 cm^2 and a sensitive volume of not more than 500 cc.

4.1.2 For measurements at 5 cm from the surface of the protective tube housing, the detector shall have an area of approximately 10 cm^2 and a sensitive volume of not more than 5 cc.

4.2 The exposure-rate meter used shall have an accuracy better than ±10 percent.

4.3 Calibration — The survey meter shall be calibrated by exposure to an X-ray field of known energy. The calibrating exposure rate shall be representative of the intensities to be measured. The calibration shall be periodically checked using an appropriate standard source. The calibration shall also be traceable to a suitable primary standard such as a free air ionization chamber.

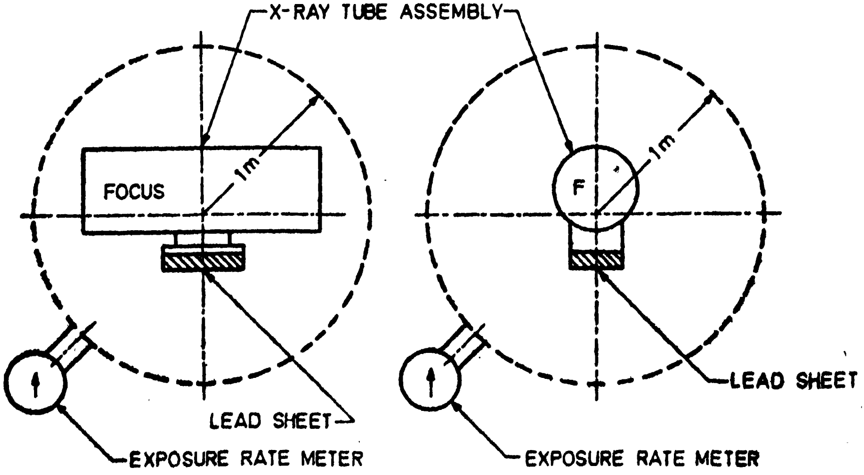
NOTE — The half value thickness of the stated material corresponding to the known value of the voltage and filtration to be used as well as the method of calibrating the survey meter are under consideration.

5. MEASUREMENT OF LEAKAGE RADIATION

5.1 The window of the protective tube housing shall be suitably covered with at least 10 HVL of lead. The window shall be properly covered so as to reduce the scattered radiation to a minimum.

5.2 The leakage radiation shall be measured with the tube operating at its maximum voltage and at its minimum current for continuous operation at that voltage. If this is not possible, the measurement shall be made at a higher current provided that the limits of operating time imposed by the total heat capacity of the tube or target (as determined from the manufacturer's tube rating and cooling charge) are taken into account.

5.3 The leakage radiation shall be measured at the specified distance (*see* Table 1) in all directions (*see* Fig. 1).



1A Horizontal   1B Vertical

FIG. 1 SET-UP FOR THE MEASUREMENT OF LEAKAGE RADIATION

6. PRECAUTIONS

6.1 The presence of radio frequency field may cause irregular or apparently high background readings in the survey meter. It should, therefore, be ensured that there is no extraneous radio frequency field before any measurement of X-radiation is carried out. This shall be done by observing the response of the survey meter without the tube being energised.

6.2 The personnel conducting the leakage radiation measurements should wear appropriate protective equipment (for example, lead rubber apron) and also should be monitored for the doses received by them by means of personnel monitoring devices (for example, film badges).

6.3 Precautions should also be taken to protect against high voltage hazards normally associated with the tube being energized.

7. REPLACEMENT OF TUBES

7.1 If at any time after original manufacture, the manufacturer or any other person or organization replaces or exchanges the X-ray tube in the protective tube-housing it is the responsibility of that person or organization to ensure that all requirements of this standard are still maintained.

INDIAN STANDARDS ON Electron Tubes

IS:

1885 (Part IV/Sec 1)-1965 Electrotechnical vocabulary : Part IV Electron tubes and valves, Section 1 Receiving valves

1885 (Part IV/Sec 2)-1965 Electrotechnical vocabulary : Part IV Electron tubes and valves, Section 2 X-ray tubes

1885 (Part IV/Sec 3)-1970 Electrotechnical vocabulary : Part IV Electron tubes and valves, Section 3 Microwave tubes

1885 (Part IV/Sec 4)-1970 Electrotechnical vocabulary : Part IV Electron tubes and valves, Section 4 Cathode-ray tubes

2032 (Part IX)-1969 Graphical symbols used in electrotechnology : Part IX Electron tubes and valves (other than microwave tubes and valves)

2032 (Part XIII)-1971 Graphical symbols used in electrotechnology : Part XIII Microwave tubes

2597 (Part I)-1964 Code of practice for the use of electronic valves : Part I Commercial receiving valves

2597 (Part II)-1967 Code of practice for the use of electronic valves : Part II Special quality receiving valves

2597 (Part III)-1969 Code of practice for the use of electronic valves : Part III Transmitting and industrial valves

2597 (Part IV)-1970 Code of practice for the use of electronic valves : Part IV Cathode-ray tubes

2597 (Part V)-1971 Code of practice for the use of electronic valves : Part V Rectifiers and thyratrons

2612-1965 Recommendation for type approval and sampling procedures for electronic components

2684 (Part I)-1972 Dimensions of electronic valves : Part I Miniature 9-pin noval type

2684 (Part II)-1972 Dimensions of electronic valves : Part II Miniature 7-pin type

2684 (Part III)-1971 Dimensions of electronic valves : Part III Octal base type

2684 (Part IV)-1971 Dimensions of electronic valves : Part IV Magnoval base type

2684 (Part V)-1972 Dimensions of electron tubes : Part V Loctal base type

3154-1965 X-ray tubes, diagnostic type

4096-1967 Method of measurement of optical focal spot size of X-ray tubes

4147-1967 Method of measurements on conventional receiving electronic valves

4579-1968 Methods of measurements on television picture tubes

4697-1968 Methods of measurements on Geiger-Muller counter tubes

5323-1969 Letter symbols and abbreviations for electron tubes and valves

5627-1970 Methods of measurements on cathode-ray display tubes

5840 (Part I)-1970 Dimensions of cathode-ray tubes : Part I Tube outlines

5840 (Part II)-1970 Dimensions of cathode-ray tubes : Part II Bases

5840 (Part III)-1970 Dimensions of cathode-ray tubes : Part III EHT terminals

6134 (Part I/Sec 1)-1971 Methods of measurement on microwave tubes : Part I General measurements, Section 1 General conditions

6134 (Part I/Sec 2) -1972 Methods of measurements on microwave tubes : Part I General measurements, Sec 2 Measurements common to all devices

6136-1971 Basic requirements for cathode-ray tubes

6214-1971 Phosphors for cathode-ray tubes

6567-1972 Radiation protection for an X-ray tube in a protective tube housing, operating between 10 kV and 400 kV

6568-1972 Implosion protection for TV picture tubes

PUBLICATIONS OF INDIAN STANDARDS INSTITUTION

INDIAN STANDARDS

Over 6 500 Indian Standards covering various subjects have been issued so far. Of these, the standards belonging to the Electrotechnical Group fall under the following categories:

- Acoustics and acoustical measurement
- Automobile electrical equipment
- Batteries
- Cinematographic equipment
- Conductors and cables
- Domestic electrical appliances
- Electric welding equipment
- Electrical installations, codes of practice
- Electrical instruments
- Electron tubes and valves
- Electronic components
- Electronic equipment
- Environmental testing procedures
- Fans
- Flameproof electrical equipment
- High voltage techniques
- Illuminating engineering
- Instrument transformers
- Insulating materials
- Insulators and accessories
- Integrating meters
- Lamps and lamp accessories
- Lifts and escalators
- Lightning arresters
- Motors and generators
- Nomenclature and symbols
- Power capacitors
- Power converters
- Relays
- Rotating machinery
- Semiconductor devices
- Switchgear and controlgear
- Transformers and reactors
- Winding wires
- Wiring accessories
- Unclassified

OTHER PUBLICATIONS

ISI Bulletin (Published Every Month)	
Single Copy	**Rs 3·00**
Annual Subscription	**Rs 25·00**
Standards: Monthly Additions	
Single Copy	**Re 0·30**
Annual Subscription	**Rs 3·00**
Annual Reports (from 1948-49 Onwards)	**Rs 2·00 to 5·00**
ISI Handbook, 1972	**Rs 20·00**

INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 1

Telephone : 27 01 31 (20 lines) **Telegrams : Manaksanstha**

Branch Offices :

		Telephone
'Sadhna', Nurmohamed Shaikh Marg, Khanpur	**Ahmedabad 1**	**2 03 91**
F Block, Unity Bldg, Narasimharaja Square	**Bangalore 2**	**2 76 49**
534 Sardar Vallabhbhai Patel Road	**Bombay 7**	**35 69 44**
5 Chowringhee Approach	**Calcutta 13**	**23-08 02**
5-9-201/2-A (First Floor), Chirag Ali Lane	**Hyderabad 1**	**5 34 35**
117/418 B Sarvodaya Nagar	**Kanpur 5**	**82 72**
54 General Patters Road	**Madras 2**	**8 72 78**

Printed at Delhi Printers, Delhi 6, India